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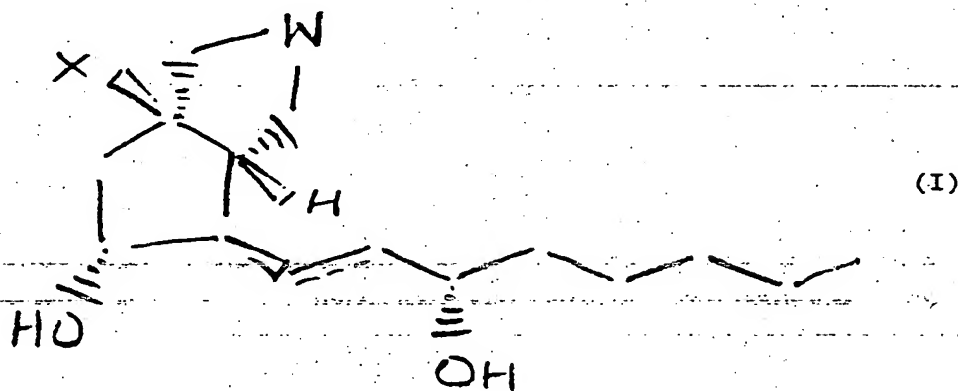
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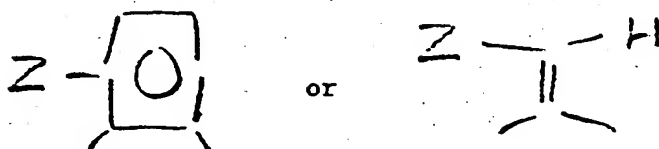
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(54) Use of prostaglandin derivatives in the treatment of congestive heart failure.

(57) The present invention is concerned with the use of a compound of formula (I)



wherein
-W- is



wherein Z is $-V(CH_2)_bCO_2H$ where b is 1 or 2 and V is oxygen when b is 1 or methylene when b is 2;
X is hydrogen, cyano, or $-C\equiv CH$; and
the dotted line represents an optional double bond;
and physiologically functional derivatives thereof,
in the manufacture of a medicament for the prophylaxis or treatment of congestive heart failure.

The medicaments obtained thereby and their use in the prophylaxis and treatment of congestive heart failure are also within the scope of the invention.

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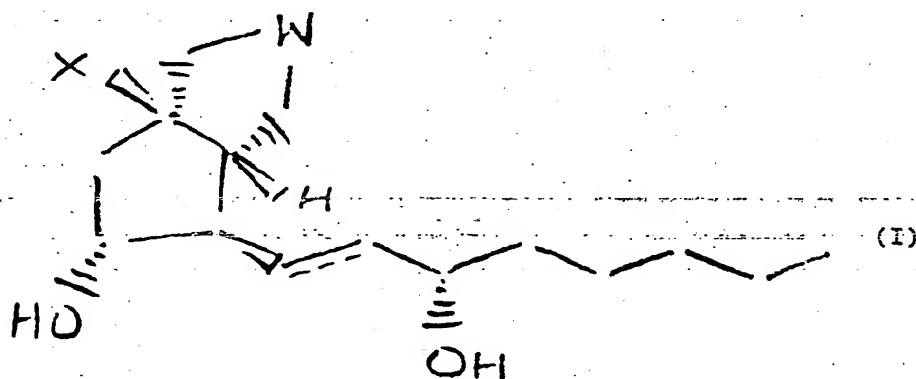
The present invention is concerned with prostaglandins for use in the prophylaxis or treatment of congestive heart failure (CHF). In particular, it relates to the use of the compounds of the invention in the manufacture of medicaments for the prophylaxis and treatment of CHF, to medicaments obtained thereby and to the prophylaxis and treatment of CHF using such medicaments.

CHF is a clinical syndrome characterized by a limitation of exercise tolerance due to dyspnea and/or fatigue which can be attributed to an abnormality in cardiac function. Such cardiac dysfunction may be secondary to alterations in cardiac filling or cardiovascular transport (or both) and is associated with identifiable changes in systolic and diastolic function which can lead to pulmonary hypertension. CHF can be attributed to failure of the right side or the left side of the heart, the latter being more common. In 'right-sided CHF', the right ventricle is unable to eject sufficient (deoxygenated) blood into the lungs to subsequently provide the body tissues with enough oxygen. In 'left-sided CHF', the left ventricle is unable to eject sufficient (oxygenated) blood into the body to satisfy its oxygen requirements. Both types of CHF can, if untreated, lead to the aforementioned symptoms and early death.

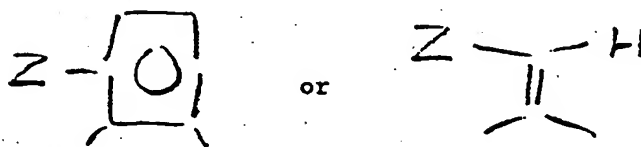
U.S. Patent 4,306,075 describes novel benzindene prostaglandins which produce various pharmacological responses, such as inhibition of platelet aggregation, reduction of gastric secretion and bronchodilation. It is indicated that the compounds have useful application as anti-thrombotic agents, anti-ulcer agents and anti-asthma agents. There is no suggestion or disclosure that they may be used in the prophylaxis and treatment of CHF.

European Patent Specification 0347243 describes a class of benzindene and non-benzindene prostaglandins suitable for use in the prophylaxis, treatment and diagnosis of pulmonary hypertension and Raynaud's disease. We have now identified a sub-class of the compounds described in European Patent Specification 0347243 which have unexpectedly been found to have potent systemic and pulmonary vascular effects which render them suitable for use in the prophylaxis or treatment of CHF. The compounds of the invention may be used in the treatment of both right- and left-sided CHF when accompanied or unaccompanied by pulmonary hypertension. They are expected to be particularly useful in the treatment of CHF when unaccompanied by pulmonary hypertension. Thus early (mild to moderate) or late (severe) left-sided CHF responds favourably to treatment with the compounds of the invention prior to the onset of pulmonary hypertension.

The present invention, therefore, lies in the use of a compound of formula (I)



wherein
-W- is



wherein Z is $-V(CH_2)_bCO_2H$ where b is 1 or 2 and V is oxygen when b is 1 or methylene when b is 2;

X is hydrogen, cyano, or $-C\equiv CH$; and

the dotted line represents an optional double bond;

and physiologically acceptable base salts, esters and other physiologically functional derivatives thereof, in the manufacture of a medicament for the prophylaxis or treatment of congestive heart failure.

The term "physiologically functional derivative" is used herein to denote a bioprecursor or "pro-drug" which may be converted to a compound of formula (I) *in vivo*, for example, an amide wherein the nitrogen is optionally substituted by one or two C₁₋₄ alkyl groups.

All references hereinafter to "a compound of formula (I)" include references to its physiologically acceptable base salts, esters and other physiologically functional derivatives.

In animal tests, it has been found that the compounds of formula (I) are potent pulmonary vasodilators and markedly attenuate the pulmonary vasoconstriction induced by hypoxia. In normotensive and pulmonary hypertensive animals, the acute beneficial haemodynamic effects observed during the administration of a compound of formula (I) include substantial reductions in pulmonary vascular resistance, pulmonary arterial pressure, systemic vascular resistance and mean arterial blood pressure and increases in cardiac output and stroke volume. All of these effects are likely to be beneficial in the prophylaxis and treatment of CHF.

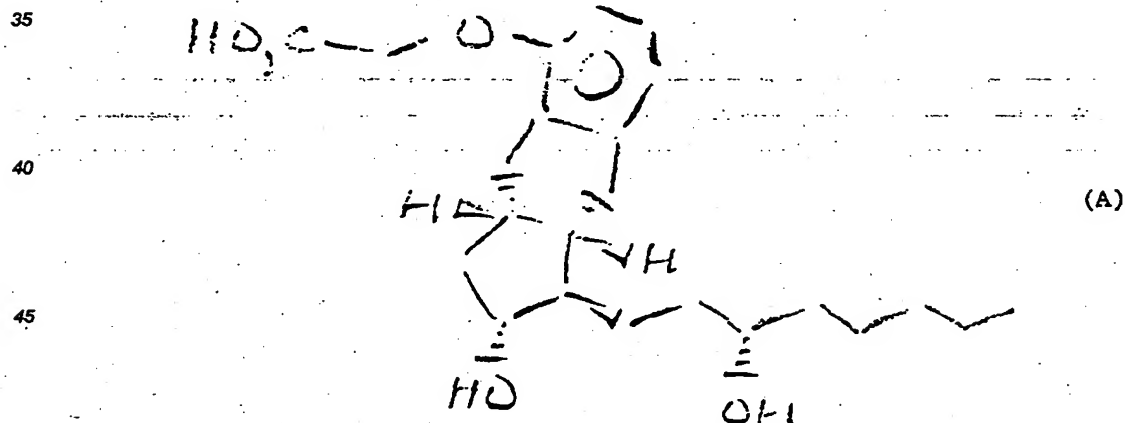
In normotensive dogs, it has interestingly been found that administration of an ACE-inhibitor, a cardiotonic, or a diuretic, either simultaneously with or immediately prior to, the administration of a compound of formula (I) respectively blocks, attenuates and potentiates the increase in Angiotensin II plasma concentration induced by the compound of formula (I) without significantly affecting its haemodynamic profile. Pre-treatment with an ACE-inhibitor also enhanced the cardiovascular effects of the compound of formula (I). However, it is not considered advisable to administer the compound of formula (I) with a diuretic in the absence of an ACE-inhibitor and/or a cardiotonic. Preferred compounds for co-administration with a compound of formula (I) include the ACE-inhibitors enalapril, captopril and lisinopril, the cardiotonic digoxin and the diuretics furosemide and butemide.

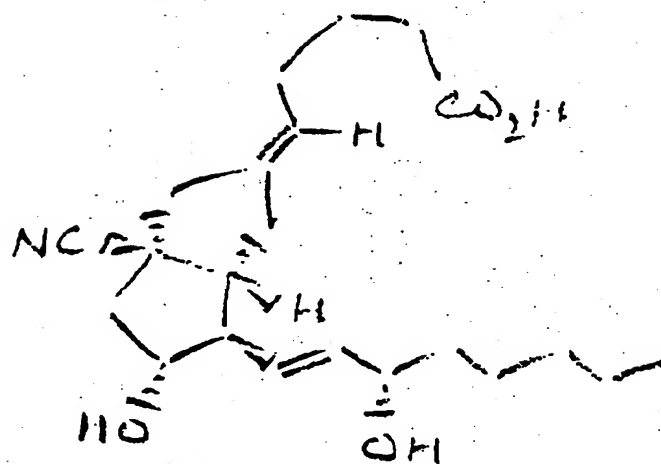
According to further aspects of the invention, therefore, there are also provided:

- (a) medicaments for the prophylaxis or treatment of CHF comprising a compound of formula (I), a pharmaceutically acceptable carrier and, optionally, one or more other therapeutically active compounds; and
- (b) a method for the prophylaxis or treatment of CHF in a mammal, such as a human, which comprises the administration of a therapeutically effective amount of a compound of formula (I) to said mammal.

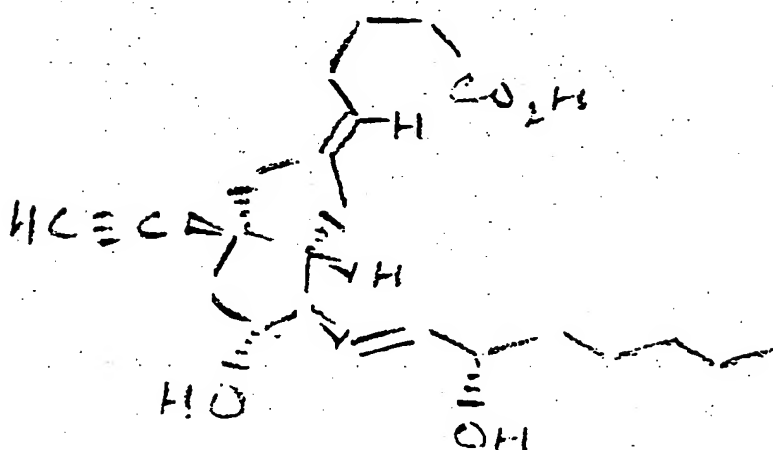
Preferred compounds of formula (I) having particularly advantageous properties in respect of the prophylaxis and treatment of CHF are

- (1R,2R,3aS,9aS)-[2,3,3a,4,9,9a-hexahydro-2-hydroxy-1-((S)-3-hydroxyoctyl)-1H-benz[*f*]inden-5-yl]oxy}acetic acid (also known as (1R-(1 α (S*),2 β ,3 α ,9 α))-[(2,3,3a,4,9,9a-hexahydro-2-hydroxy-1-(3-hydroxyoctyl)-1H-benz[*f*]inden-5-yl]oxy}acetic acid) having formula (A),
- (5Z,9R)-9-cyano-6a-carbaprostaglandin I₂ (B) and
- (5Z,9R)-9-ethynyl-6a-carbaprostaglandin I₂ (C):





(B)



(C)

and physiologically acceptable base salts, esters and other physiologically functional derivatives of any thereof.

Of these preferred compounds of formula (I), compound (A) and its physiologically acceptable base salts, esters and other physiologically functional derivatives are particularly preferred, especially compound (A) itself.

Base salts in accordance with the invention include ammonium salts, alkali metal salts such as those of sodium and potassium, alkaline earth metal salts such as those of calcium and magnesium, salts with organic bases such as dicyclohexylamine and N-methyl-D-glutamine, and salts with amino acids such as arginine and lysine.

The amount of a compound of formula (I) which is required for the prophylaxis or treatment of CHF will depend on a number of factors, in particular, the nature and severity of the condition being treated and the preferred mode of administration. In general, a daily dose for the prophylaxis or treatment of congestive heart failure is in the range 25 µg to 250 mg, typically from 1.0 µg to 0.05 mg, per day per kilogram bodyweight. For example, an intravenous dose may be in the range 0.5 µg to 1.5 mg/kg/day, which may conveniently be administered as an infusion of from 0.5 ng to 1.0 µg per kilogram per minute. Infusion fluids suitable for this purpose may contain, for example, from 10 ng to 10 µg per millilitre of the active compound. Ampoules for injection may contain, for example, from 0.1 µg to 1.0 mg and orally administrable unit dose formulations, such as tablets or capsules, may contain, for example, from 0.1 to 100 mg, typically from 1 to 50 mg. In the case of physiologically acceptable salts, the weights indicated above refer to the weight of the anion of the active compound.

The manufacture of a medicament in accordance with the invention typically involves admixing a compound of formula (I) with one or more carriers. The latter must, of course, be acceptable in the sense of being compatible with any other ingredients in the medicament and must not be deleterious to the patient. The carrier may be a solid or a liquid, or both, and is preferably formulated with the active compound as a unit-dose medicament, for example, a tablet, which may contain from 0.05% to 95% by weight of the active compound. The compound of formula (I) may be incorporated in the medicaments of the invention by any of the well known techniques of pharmacy which involve admixing the components.

Medicaments according to the invention include those suitable for oral, buccal (e.g. sub-lingual), parenteral (e.g. subcutaneous, intramuscular, intradermal and intravenous), rectal, topical, transdermal, nasal and pulmonary administration, although the most suitable route in any given case will depend on the nature and severity of the condition being treated.

5 Medicaments suitable for oral administration may be presented in discrete units adapted for instant or controlled release, such as capsules, cachets, lozenges, or tablets, each containing a predetermined amount of a compound of formula (I); as a powder or granules; as a solution or a suspension in an aqueous or non-aqueous liquid; or as an oil-in-water or water-in-oil emulsion. Such formulations may be prepared by any suitable method of pharmacy which includes the step of bringing into association the active compound and a suitable carrier (which may contain one or more accessory ingredients). In general, the formulations of the invention are prepared by uniformly and intimately admixing the compound of formula (I) with a liquid or finely divided solid carrier, or both, and then, if necessary, shaping the resulting mixture. For example, a tablet may be prepared by compressing or moulding a powder or granules containing the active compound, optionally with one or more accessory ingredients. Compressed tablets may be prepared by compressing, in a suitable machine, the compound in a free-flowing form, such as a powder or granules optionally mixed with a binder, lubricant, inert diluent and/or surface active/dispersing agent(s). Moulded tablets may be made by moulding, in a suitable machine, the powdered compound moistened with an inert liquid binder.

Medicaments suitable for buccal (e.g. sub-lingual) administration include lozenges comprising a compound of formula (I) in a flavoured base, usually sucrose and acacia or tragacanth; and pastilles comprising the compound in an inert base such as gelatin and glycerin or sucrose and acacia.

Medicaments suitable for parenteral administration conveniently comprise sterile aqueous preparations of a compound of formula (I), which preparations are preferably isotonic with the blood of the intended recipient. These preparations are preferably administered intravenously, although administration may also be effected by means of subcutaneous, intramuscular, or intradermal injection. Such preparations may conveniently be prepared by admixing the compound with water or a suitable buffer, for example, a glycine or citrate buffer, and rendering the resulting solution sterile and isotonic with the blood (pH range: 3.5-8.5). Injectable preparations according to the invention generally contain from 0.1 to 5 mg/ml of active ingredient and may be diluted to a concentration of from 0.0001 to 0.05% w/v of active ingredient prior to administration. Parenteral administration is typically carried out at a rate of 0.001 ml/min/kg or more.

Medicaments suitable for rectal administration are preferably presented as unit dose suppositories. These may be prepared by admixing a compound of formula (I) with one or more conventional solid carriers, for example, cocoa butter, and then shaping the resulting mixture as required.

Medicaments suitable for topical application to the skin preferably take the form of an ointment, cream, lotion, paste, gel, spray, aerosol, or oil. Carriers which may be used include vaseline, lanoline, polyethylene glycols, alcohols, and combinations of two or more thereof. The compound of formula (I) is generally present at a concentration of from 0.001 to 1.0% w/w, for example, from 0.005 to 0.2% w/w.

Medicaments suitable for transdermal administration may take the form of an optionally buffered aqueous solution of a compound of formula (I) and may be delivered by passive diffusion or by electrically-assisted transport, for example, iontophoresis (see, for example, *Pharmaceutical Research* 3(6), 318 (1986)).

40 For nasal administration, a particle size in the range 10 - 500µm is preferred to ensure retention in the nasal cavity. For pulmonary administration via the mouth, the particle size of the powder or droplets is typically in the range 0.5 - 10µm, preferably 1 - 5µm, to ensure delivery into the bronchial tree.

Metered dose inhalers are pressurised aerosol dispensers, typically containing a suspension or solution formulation of the active ingredient in a liquefied propellant. During use, these devices discharge the formulation through a valve adapted to deliver a metered volume, typically from 10 to 150µl, to produce a fine particle spray containing the active compound. Suitable propellants include certain chlorofluorocarbon compounds, for example, dichlorodifluoromethane, trichlorofluoromethane, dichlorotetrafluoroethane and mixtures thereof. The formulation may additionally contain one or more co-solvents, for example, ethanol, spreading agents, such as surfactants, for example, oleic acid, sorbitan trioleate, or Exosurf Neonatal, antioxidants and suitable flavouring agents.

Exosurf Neonatal is a protein-free synthetic lung surfactant consisting of an aqueous suspension of colfosceril palmitate (dipalmitoylphosphatidylcholine), cetyl alcohol, tyloxapol (formaldehyde polymer with oxirane and 4-(1,1,3,3-tetramethylbutyl)phenol) and sodium chloride with the pH adjusted to a value of from 5 to 7.

55 Nebulisers are commercially available devices which transform solutions or suspensions of the active ingredient into a therapeutic aerosol mist either by means of acceleration of a compressed gas through a narrow venturi orifice, typically air or oxygen, or by means of ultrasonic agitation. Suitable formulations for use in nebulisers consist of the active ingredient in a liquid carrier, the active ingredient comprising up to 40% w/w of the formulation, but preferably less than 20% w/w. The carrier is typically water or a dilute aqueous alcoholic sol-

ution, preferably made isotonic with body fluids by the addition of, for example, sodium chloride. Other suitable carriers include surfactants, such as Exosurf Neonatal. Optional additives include preservatives if the formulation is not prepared sterile, for example, methyl hydroxybenzoate, antioxidants, flavouring agents, volatile oils, buffering agents and spreading agents, such as surfactants, for example, Exosurf Neonatal.

Formulations suitable for administration by insufflation include finely comminuted powders which may be delivered by means of an insufflator or taken into the nasal cavity in the manner of a snuff. In the insufflator, the powder is contained in capsules or cartridges, typically made of gelatin or plastic, which are either pierced or opened in situ and the powder delivered by air drawn through the device upon inhalation or by means of a manually-operated pump. The powder employed in the insufflator consists either solely of the active ingredient or of a powder blend comprising the active ingredient, a suitable powder diluent, such as lactose, and an optional spreading agent. The active ingredient typically comprises from 0.1 to 100 w/w of the formulation.

The compounds of the present invention are conveniently prepared by methods which are the same as or analogous to those described in the aforementioned U.S. Patent 4,306,075 and European Patent Specification 0086611.

For a better understanding of the invention, the following Examples are given by way of illustration.

EXAMPLES

Biological tests

The cardiovascular effects of the compound of formula (A) were examined in both anaesthetised and conscious animals. The results are shown in Tables 1 to 4.

Table 1Hypotensive effects of the compound of
formula (A) in anaesthetised animals

Species	Dose	Route	BP change (mm Hg)	n
Rat	25 µg/kg	s.c.	29 ± 4	4
	50 µg/kg	s.c.	36 ± 3	4
	100 µg/kg	s.c.	60 ± 5	5
	0.4 µg/kg/min	i.v.	31	—
	1 mg/kg	p.o.	35 ± 7	6
Rabbit	5 mg/kg	p.o.	55 ± 9	3
	0.05 µg/kg/min	i.v.	8 ± 3	3
	0.1 µg/kg/min	i.v.	18 ± 6	3
	0.2 µg/kg/min	i.v.	28 ± 9	3
	0.4 µg/kg/min	i.v.	48 ± 8	3
Cat	0.5 µg/kg/min	i.v.	54 ± 11	3
	3 µg/kg/min	i.v.	22 ± 8 (D)	4
	10 µg/kg/min	i.v.	36 ± 16 (D)	4
Dog	30 µg/kg/min	i.v.	74 ± 9 (D)	4
	0.32 µg/kg	i.v.	8 ± 2	5
	1 µg/kg	i.v.	14 ± 2	5
	3.2 µg/kg	i.v.	36 ± 2	5
	0.1 µg/kg/min	i.v.	8 ± 4	3
	0.3 µg/kg/min	i.v.	27 ± 12	3
	1 µg/kg/min	i.v.	62 ± 12	3

Results are shown as the reduction in mean systemic arterial blood pressure or diastolic blood pressure (D), expressed as mean ± S.E.M. All blood pressure (BP) changes shown are statistically significant (P < 0.05).

Table 2

Haemodynamic and electrocardiogram effects
of intravenous infusions of the compound of
formula (A) in the anaesthetised dog

		<u>Compound A ($\mu\text{g/kg/min}$)</u>			
	Pre-infusion value	0.1	0.3	1.0	
15	<u>Hemodynamic Parameter</u>				
	Mean Blood Pressure (mm Hg)	136 ± 5	$-8 \pm 4^*$	$-27 \pm 12^*$	$-62 \pm 12^*$
20	Total Peripheral Resistance (peripheral resistance units)	3.2 ± 0.5	$-0.2 \pm 0.4^*$	$-0.7 \pm 0.6^*$	$-1.4 \pm 0.5^*$
	Left Ventricular End Diastolic Pressure (mm Hg)	4.2 ± 1.0	0.7 ± 0.8	0.2 ± 1.0	-0.9 ± 1.3
25	Heart Rate (bpm)	147 ± 12	9.0 ± 8.4	2.0 ± 6.6	-9.0 ± 2.4
	Cardiac Index (ml/min/kg)	152 ± 15	6 ± 18	26 ± 40	0.2 ± 23
30	LVdP/dt (mm Hg/sec)	2339 ± 404	101 ± 161	-105 ± 113	$-648 \pm 39^*$
35	<u>Electrocardiogram Parameter</u>				
	ST-segment elevation (mV)	-0.06 ± 0.07	0 ± 0.03	-0.02 ± 0.02	0.0 ± 0.04
40	PR-interval (msec)	104 ± 2.3	-3.3 ± 2.9	-2.3 ± 5.0	4.7 ± 6.4
	QT _c -interval (msec)	321 ± 7.7	12.7 ± 5.2	7.0 ± 2.5	-6.0 ± 2.1

Data, shown as the change from pre-infusion values for each parameter are the mean \pm S.E.M. Each dose was infused for 10 minutes. Where there is a significant change from pre-infusion value this is shown as *P<0.05.

Table 3

Hypotensive effects of the compound of formula (A)
in the conscious rat or dog

Species	Dose	Route	BP change (mm Hg)	n
Rat	1.5 mg/kg	p.o.	13 ± 2 (D)	6
	0.5 mg/kg	p.o.	28 ± 7 (D)	6
	1 mg/kg	p.o.	10 ± 3	4
	5 mg/kg	p.o.	19 ± 3	4
Dog	0.3 µg/kg/min	i.v.	13 ± 3 (D)	6
	1 µg/kg/min	i.v.	35 ± 6 (D)	6
	3 µg/kg/min	i.v.	45 ± 4 (D)	6
	0.5 mg/kg	p.o.	31 (D)	6
	1.5 mg/kg	p.o.	53 ± 11	3

Results are shown as the reduction in mean systemic arterial blood pressure or diastolic blood pressure (D), expressed as mean ± S.E.M. All blood pressure (BP) changes shown are statistically significant ($P < 0.05$).

Table 4

Haemodynamic and electrocardiogram effects of oral
administration of the compound of formula (A) (0.5 mg/kg)
in the conscious dog

Hemodynamic Parameter	Pre-dose values	Post-dosing values					
		5 min	30 min	60 min	90 min	120 min	140 min
Systolic Blood Pressure (mm Hg)	149 ± 9	113 ± 7*	120 ± 4*	122 ± 7*	136 ± 6*	124 ± 5*	147 ± 8*
Diastolic Blood Pressure (mm Hg)	67 ± 5	44 ± 7*	54 ± 2*	53 ± 5*	57 ± 6*	55 ± 4	70 ± 6
Heart Rate (bpm)	78 ± 8	102 ± 15	101 ± 6	100 ± 14	84 ± 6	79 ± 5	71 ± 4
<u>Electrocardiogram Parameter</u>							
PR-interval (Msec)	102 ± 3	-	90 ± 3*	95 ± 3	99 ± 3	106 ± 3	105 ± 4
QRS-interval (Msec)	52 ± 5	-	58 ± 5	55 ± 6	58 ± 5	53 ± 7	52 ± 6
QT _c -interval (Msec)	231 ± 7	-	230 ± 8	236 ± 10	244 ± 9	246 ± 10*	235 ± 13

Data, shown as the pre- and post-infusion values of each parameter, are the mean ± S.E.M. Where there is a significant difference from pre-dose value it is shown as *P < 0.05.

In another series of experiments, it was found that separate pretreatment of anaesthetised dogs with enalapril (0.3 mg/kg), digoxin (100 mg/kg) and furosemide (1.0 mg/kg) 30-40 minutes prior to intravenous infusion of the compound of formula (A) respectively blocked, attenuated and potentiated the increase in Angiotensin II plasma concentration induced by the latter without significantly affecting its haemodynamic profile. The results are shown in Table 5.

Table 5

Plasma Angiotensin II concentration in
anaesthetised dogs

Treatment	Pre-Treatment Mean ± S.E.M. (pg/ml)	Post-Treatment Mean ± S.E.M. (pg/ml)	Post-Treatment and Compound A Mean ± S.E.M. (pg/ml)
Saline	8.52 ± 1.40	7.43 ± 1.80	46.46 ± 14.51**
Enalapril	6.41 ± 2.43	17.5 ± 6.72	15.88 ± 6.19
Digoxin	14.04 ± 3.43	14.94 ± 7.66	24.45 ± 3.89
Furosemide	11.42 ± 1.64	28.78 ± 3.35*	87.36 ± 10.91**

* p < 0.05 from Pre-Treatment

** p < 0.05 from Post-Treatment

In yet another series of experiments, two anaesthetised dogs were given a 20 µg/kg intratracheal bolus

dose of the compound of formula (A), one as a solution in 5% ethanol/saline and the other as a solution in 5% ethanol/Exosurf Neonatal. The plasma concentration of the compound of formula (A) was monitored for each animal and the mean terminal half-life determined in each case. The half-life of the Exosurf-treated animal was found to be significantly longer than that of the saline-treated animal. Mean bioavailability with Exosurf was 88% and without Exosurf was 46%.

The haemodynamic effects observed in the animal models are likely to be beneficial in the prophylaxis and treatment of CHF.

MEDICAMENTS

10

Instant Release Tablet

mg per tablet

Active Compound	1
Lactose	79
Microcrystalline Cellulose	12
Sodium Starch Glycollate	4
Povidone BP	3
Magnesium Stearate	<u>1</u>
	100

25

Instant Release Capsule

mg per tablet

Active Compound	1
Microcrystalline Cellulose	20
Pregelatinised Starch NF	178
Magnesium Stearate	<u>1</u>
	200

35

Controlled Release Tablet

mg per tablet

Active Compound	5.0
Lactose	147.5
Methocel K4M	87.5
Povidine K30 BP	7.5
Magnesium Stearate	<u>2.5</u>
	250.0

50

Intravenous Solution

Disodium citrate solution, 0.1M	0.6ml
0.1N NaOH solution	qs to pH 6
Active Compound	0.5mg
Water for Injections	to 1ml

55

Subcutaneous and Intramuscular Solution

5	Disodium citrate solution, 0.1M	0.5ml
	0.1N NaOH solution	qs to pH 6.8
	Active Compound	0.25mg
	Dextrose	25mg
10	Water for Injections	to 1ml

Transdermal Solution

15 0.01-0.2M solution of the active compound in a citrate or bis/tris buffer (pH 6) or ethanol/water.

Toxicity

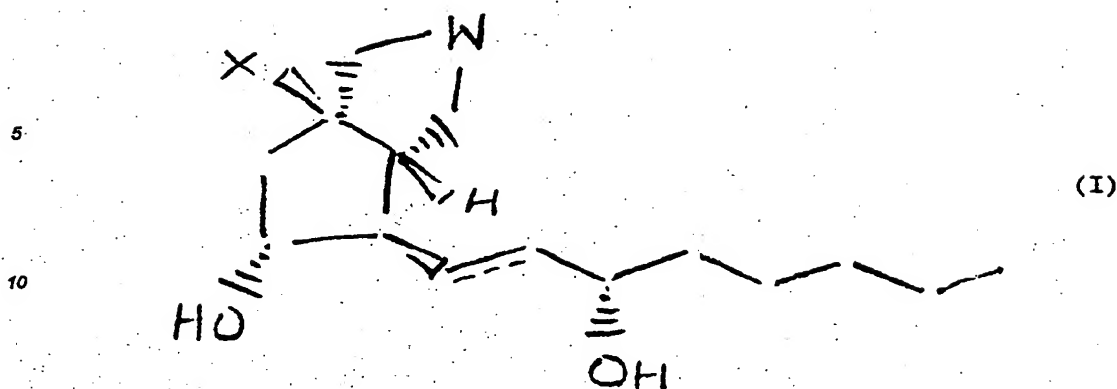
20 The compound of formula (A) was tested by oral and intravenous routes in acute and subchronic tests in mice, rats and dogs. These experiments established no effect levels and full reversibility was observed. Most effects were attributable to the known pharmacological activity of the compound of formula (A) which has a half-life measured in minutes for the species examined. The tests carried out are shown in Table 6.

Table 6Toxicity tests

Study Type	Species	Group Size M/F	Compound A Dose Levels
ORAL DOSE ROUTE			
Acute (limit test) Toxicity	Rats	10/10	75, 150, 300 mg/kg
Acute (limit test) Toxicity	Mice	10/10	150, 300 mg/kg
1-Month Toxicity Study	Rats	15/15	0.4, 1, 10 mg/kg/day
1-Month Toxicity Study	Dogs	4/4	0.04, 0.20, 1.00 mg/kg/day
INTRAVENOUS DOSE ROUTE			
Acute (limit test) Toxicity	Rats	10/10	50, 100 mg/kg
Acute (limit test) Toxicity	Mice	10/10	100 mg/kg
2-Week Continuous Infusion	Dogs	3/3	0.05, 0.10, 0.20 micrograms/kg/min
MISCELLANEOUS			
In vitro test for Hemolysis and Plasma Protein Precipitation	Dogs, Humans	NA*	20 micrograms/ml at 1:100 ratio

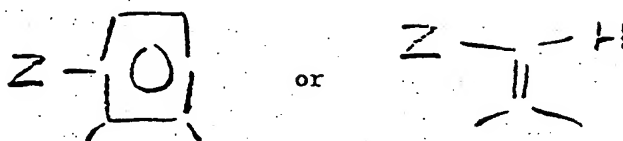
Claims

55 1. Use of a compound of formula (I)



wherein
-W- is

20



25

wherein Z is $-V(CH_2)_bCO_2H$ where b is 1 or 2 and V is oxygen when b is 1 or methylene when b is 2;
X is hydrogen, cyano, or $-C\equiv CH$; and
the dotted line represents an optional double bond;
and physiologically acceptable base salts, esters and other physiologically functional derivatives thereof;
in the manufacture of a medicament for the prophylaxis or treatment of congestive heart failure.

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2. Use according to claim 1, wherein the compound of formula (I) is (1R,2R,3aS,9aS)-([2,3,3a,4,9,9a-hexahydro-2-hydroxy-1-((S)-3-hydroxyoctyl)-1H-benz[f]inden-5-yl]oxy)acetic acid.
3. Use according to claim 1, wherein the compound of formula (I) is (5Z,9R)-9-cyano-6a-carbaprostaglandin I₂.

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4. Use according to claim 1, wherein the compound of formula (I) is (5Z,9R)-9-ethynyl-6a-carbaprostaglandin I₂.

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5. A medicament for the prophylaxis or treatment of congestive heart failure which comprises a compound of formula (I) as defined in Claim 1 or as named in any of Claims 2 to 4, a pharmaceutically acceptable carrier and, optionally, one or more other therapeutically active compounds.
6. A medicament according to Claim 5 wherein the other therapeutically active compound(s) is/are selected from an ACE-inhibitor, a cardiotonic and a diuretic, with the proviso that a diuretic can only be selected together with an ACE-inhibitor and/or a cardiotonic.
7. A medicament according to Claim 6 wherein the ACE-inhibitor is enalapril, the cardiotonic is digoxin and the diuretic is furosemide.
8. A medicament according to any of Claims 5 to 7 which is in a form suitable for oral, buccal, parenteral, rectal, topical, transdermal, nasal, or pulmonary administration.
9. A medicament according to any of Claims 5 to 8 wherein the pharmaceutically acceptable carrier is or contains Exosurf Neonatal.

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10. A method of preparing a medicament for the prophylaxis or treatment of congestive heart disease which

comprises admixing a compound of formula (I) as defined in Claim 1 or as named in any of Claims 2 to 4 with a pharmaceutically acceptable carrier and, optionally, one or more other therapeutically active compounds.

- 5 11. A method according to Claim 10 wherein the pharmaceutically acceptable carrier is or contains Exosurf Neonatal.

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